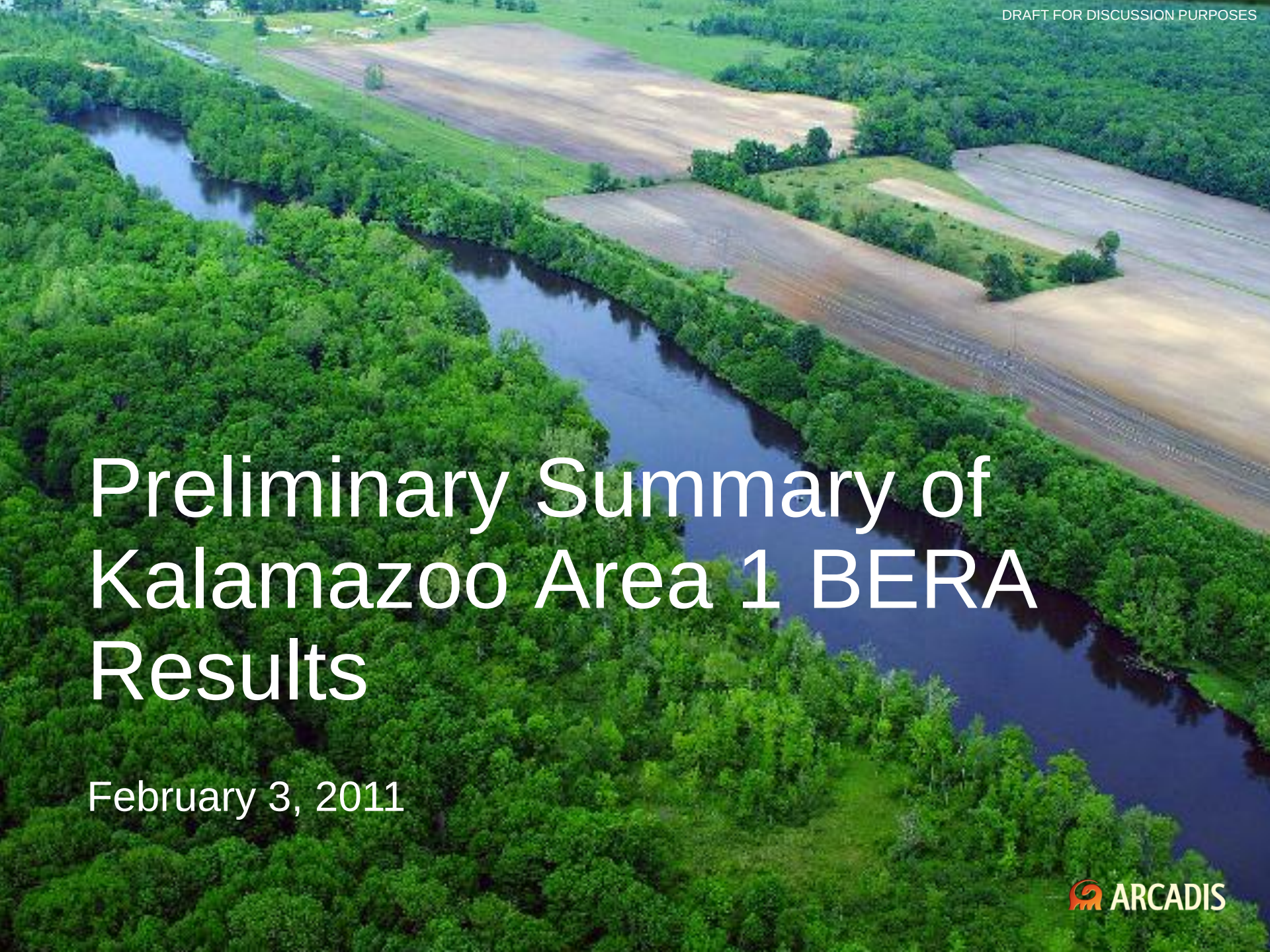

Preliminary Summary of Kalamazoo Area 1 BERA Results

February 3, 2011

ARCADIS

Overview of Assessment Endpoints and Representative Receptors

Sustainability of Local Insectivorous Bird Populations

- House Wren

Sustainability of Local Vermivorous Bird Populations

- American Robin
- American Woodcock

Sustainability of Local Carnivorous Bird Populations

- Red-tailed Hawk

Sustainability of Local Vermivorous Mammal Populations

- Short-tailed Shrew

Sustainability of Local Carnivorous Mammal Populations

- Red Fox

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Assessment Endpoint: Lines of Evidence
Insectivorous Birds: House Wren

Hazard Quotients (2 acre moving window EUs)

- Dietary: tPCB: TRVs high sensitivity
- Dietary: tPCB: TRVs mid-range sensitivity
- Egg-Based: tPCB: TRVs high sensitivity
- Egg-Based: tPCB: TRVs mid-range sensitivity
- Egg-Based: TEQ: TRVs high sensitivity
- Egg-Based: TEQ: TRVs mid-range sensitivity

MSU House Wren Study

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Assessment Endpoint: Lines of Evidence
Vermivorous Birds: American Robin

Hazard Quotients (2 acre moving window EUs)

- Dietary: tPCB: TRVs high sensitivity
- Dietary: tPCB: TRVs mid-range sensitivity
- Egg-Based: tPCB: TRVs high sensitivity
- Egg-Based: tPCB: TRVs mid-range sensitivity
- Egg-Based: TEQ: TRVs high sensitivity (Approach 2)
- Egg-Based: TEQ: TRVs high sensitivity (Approach 3)
- Egg-Based: TEQ: TRVs mid-range sensitivity (Approach 2)
- Egg-Based: TEQ: TRVs mid-range sensitivity (Approach 3)

Measured PCB concentrations in robin eggs from the former Plainwell Impoundment

Housatonic River Robin Study

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Assessment Endpoint: Lines of Evidence
Vermivorous Birds: American Woodcock

Hazard Quotients (11 acre moving window EUs)

- Dietary: tPCB: TRVs high sensitivity
- Dietary: tPCB: TRVs mid-range sensitivity
- Egg-Based: tPCB: TRVs high sensitivity
- Egg-Based: tPCB: TRVs mid-range sensitivity
- Egg-Based: TEQ: TRVs high sensitivity
- Egg-Based: TEQ: TRVs mid-range sensitivity

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Assessment Endpoint: Lines of Evidence
Vermivorous Mammals

HQs (1 acre moving window EUs)

- Dietary: tPCB
- Dietary: TEQ

Housatonic River Shrew Study

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Assessment Endpoint: Lines of Evidence
Carnivorous Birds and Mammals

Carnivorous Birds: Red-Tailed Hawk (Site-wide EUs)

- HQs
  - Dietary: tPCB: TRVs high sensitivity
  - Dietary tPCB TRVs mid-range sensitivity

Carnivorous Mammals: Red Fox (Site-wide EUs)

- Dietary: tPCB: TRVs

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Risk Results – Avian Receptors

Two Sets of TRVs Developed for HQ analysis

- High sensitivity TRVs - based on domestic chicken studies
- Mid-Range sensitivity TRVs - based on wild species

HQs based on Mid-Range TRVs are Most Appropriate for Area 1 Receptors

- Domestic Chicken is not a representative species
- Dr. Sean Kennedy's research at the University of Ottawa indicates that chickens are significantly more sensitive to AHR mediated effects of dioxin-like chemicals than other species tested
- Mid-Range TRVs are based on the ring-necked pheasant (dietary) and the mallard and kestrel (egg-based); these species more closely represent the wild species found in Area 1

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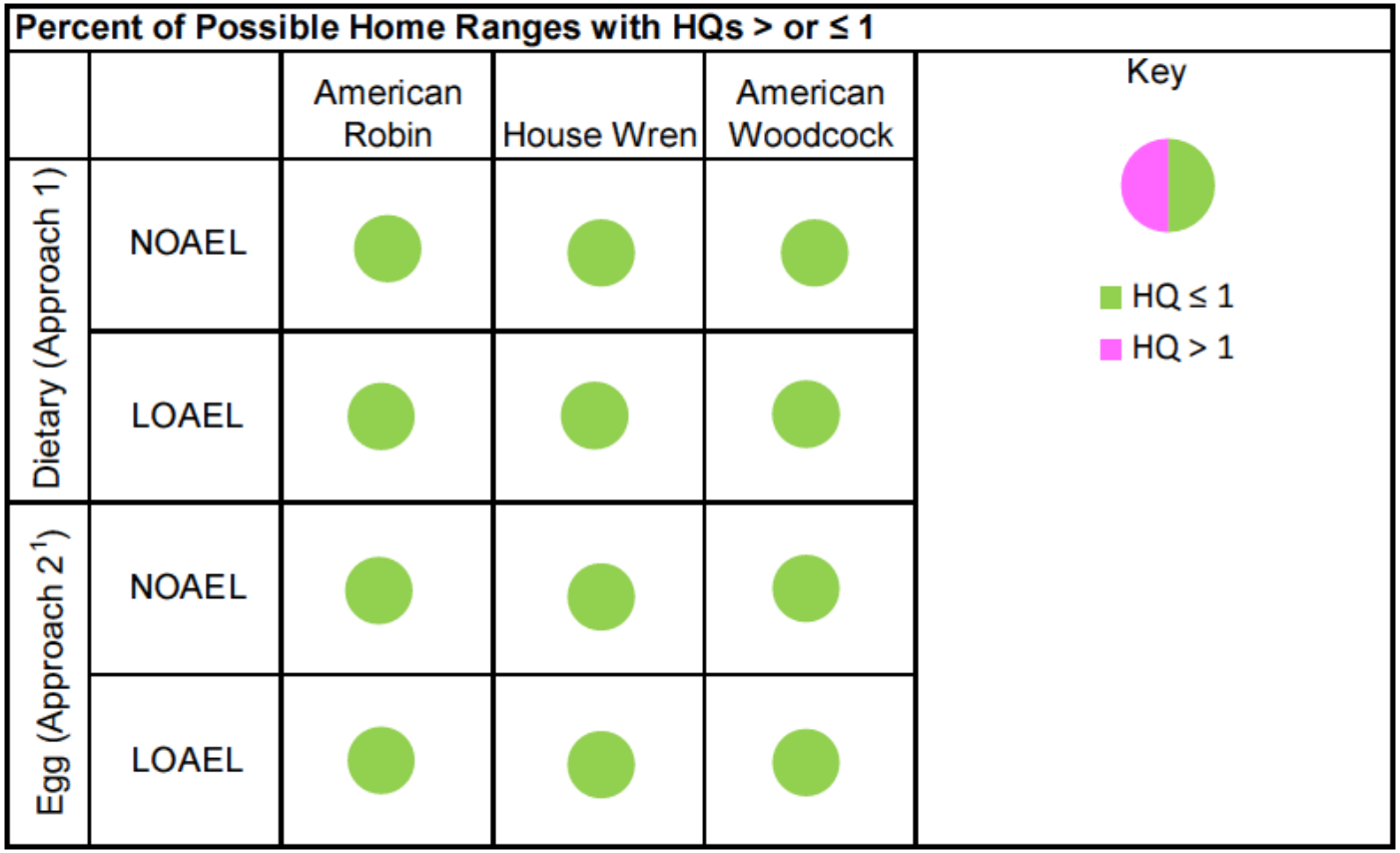
HQ Summary: Mid-Range TRVs Plainwell No. 2 Dam Area

Small Ranging Avian Receptors



Note: Results for Approach 2 are identical for tPCB and TEQ (both Approach 2 and 3 for the American Robin)

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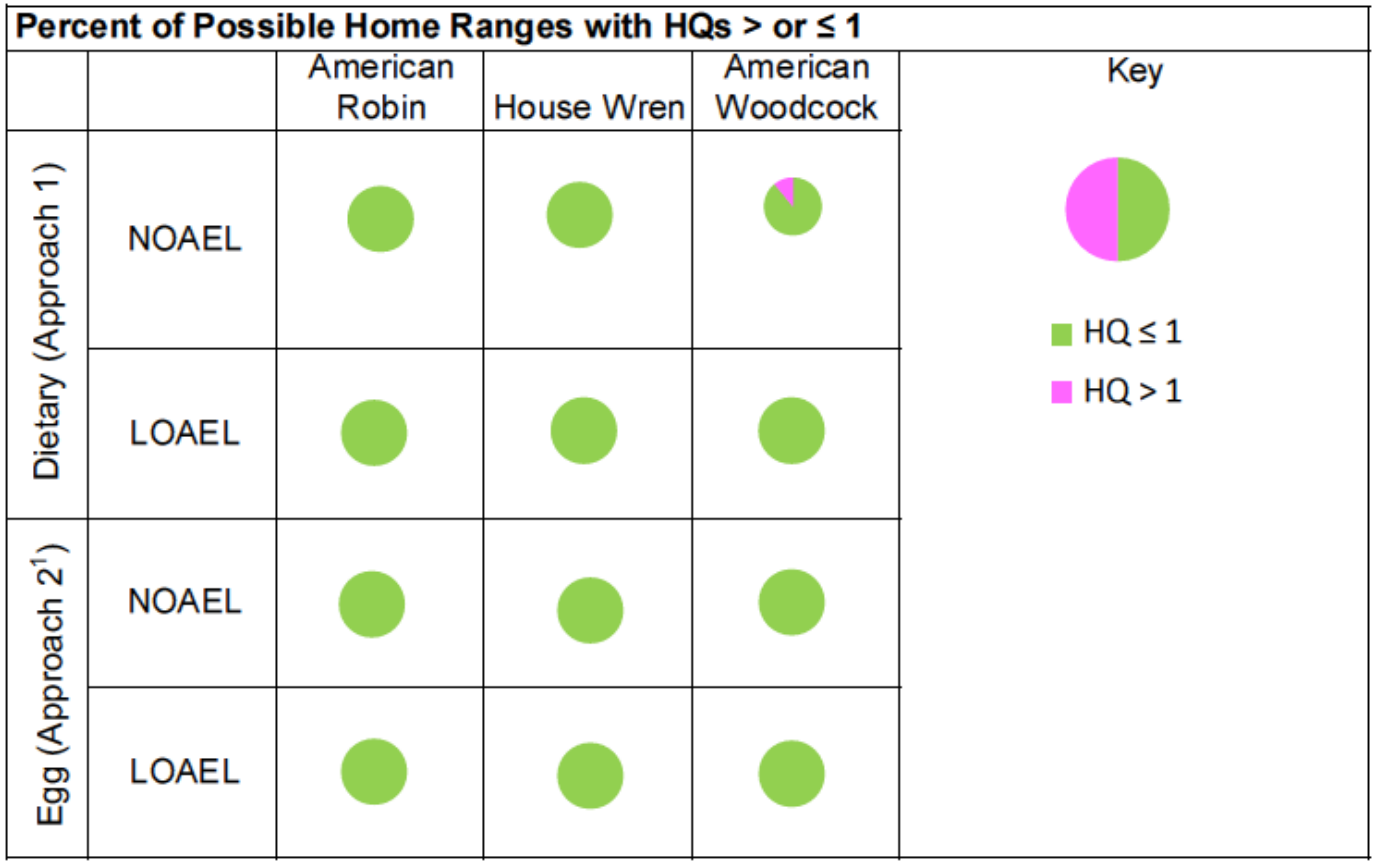
HQ Summary: Mid-Range TRVs Former Plainwell Impoundment

Small Ranging Avian Receptors



Note: Results for Approach 2 are identical for tPCB and TEQ (both Approach 2 and 3 for the American Robin)

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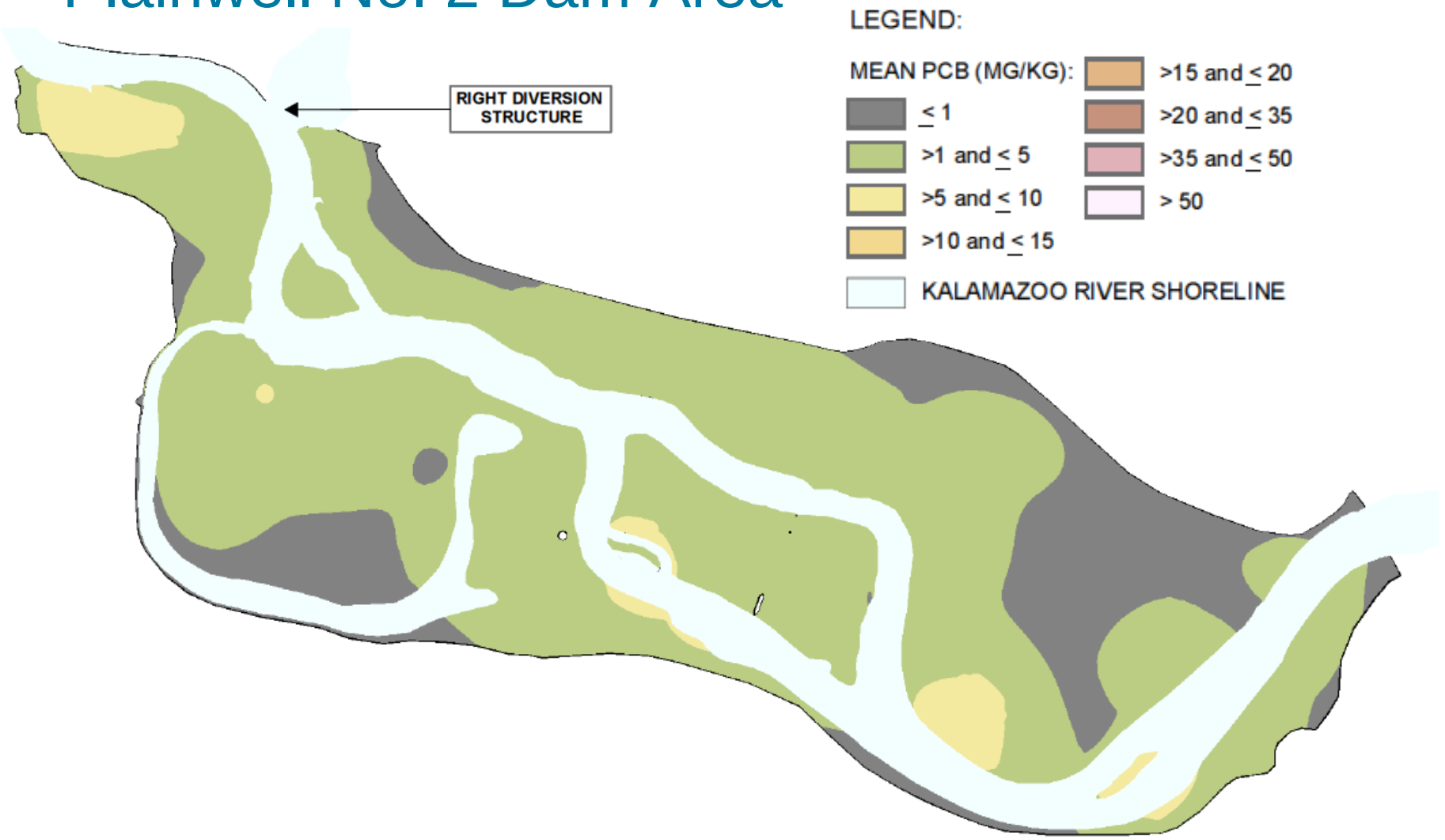
Natural Neighbor - 2 Acre Moving Window
Plainwell No. 2 Dam Area



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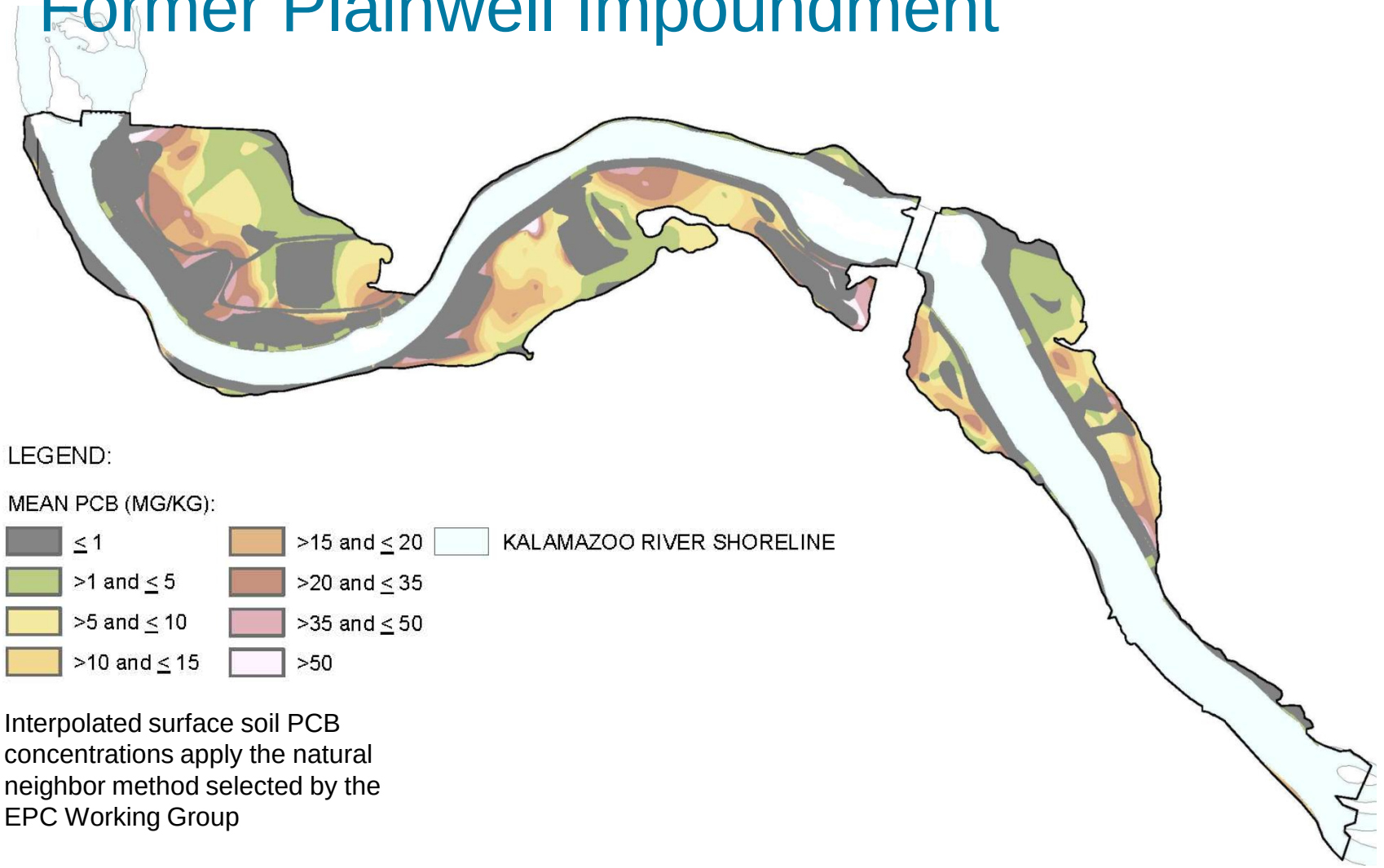
Residual Soil PCB Concentrations
Former Plainwell Impoundment



Interpolated surface soil PCB concentrations apply the natural neighbor method selected by the EPC Working Group

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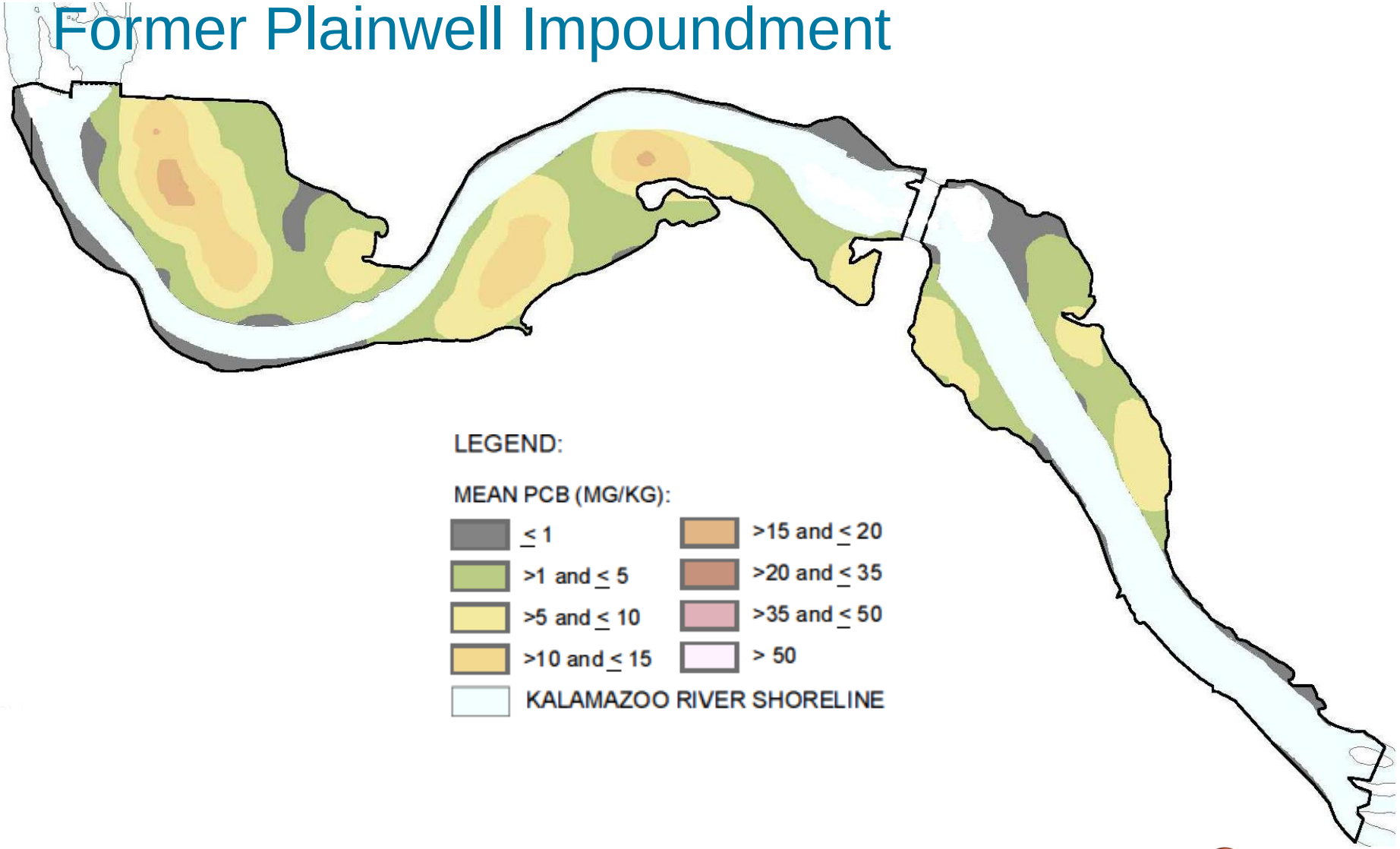
Natural Neighbor – 2-Acre Moving Window
Former Plainwell Impoundment



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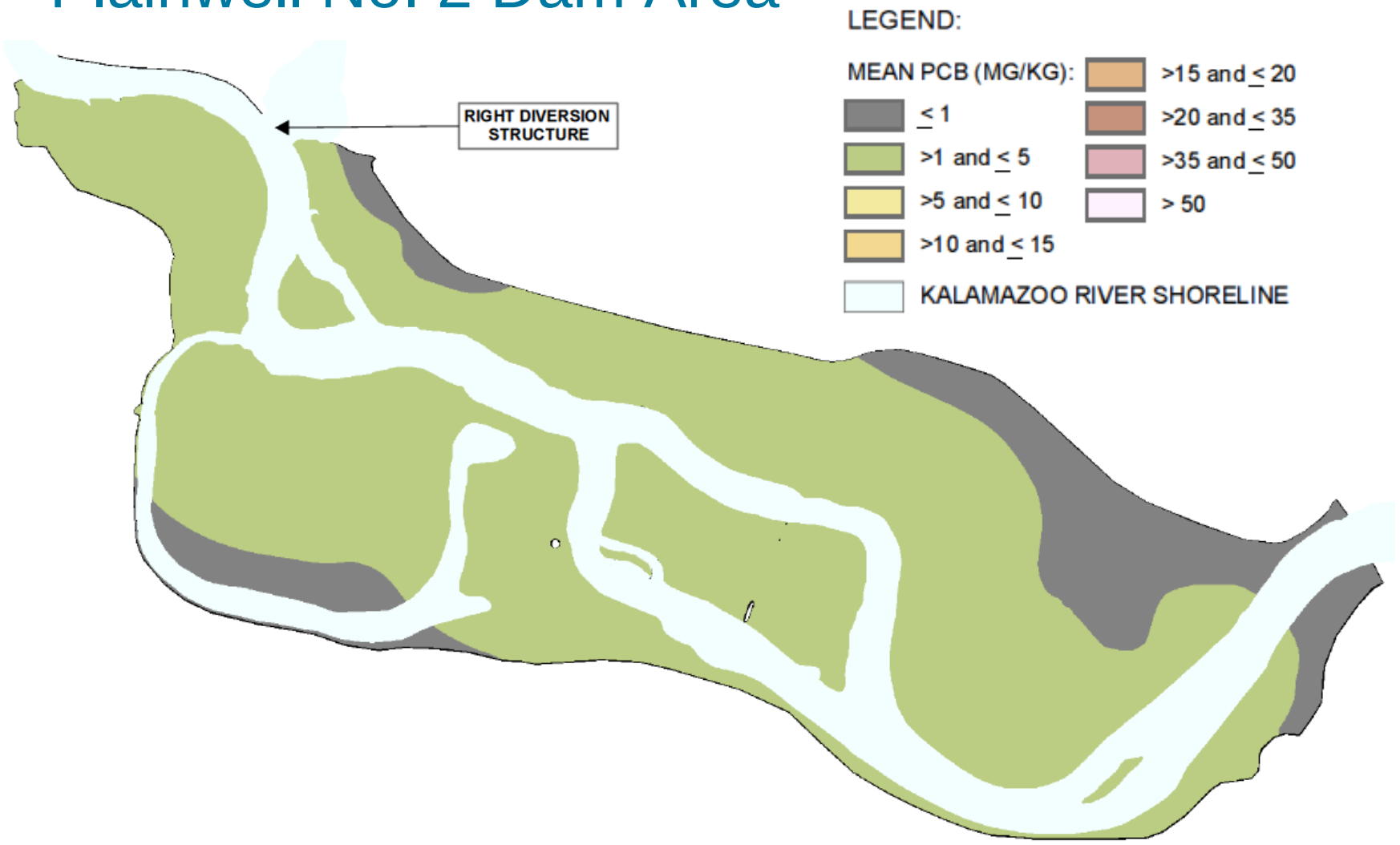
Natural Neighbor -11 Acre Moving Window
Plainwell No. 2 Dam Area



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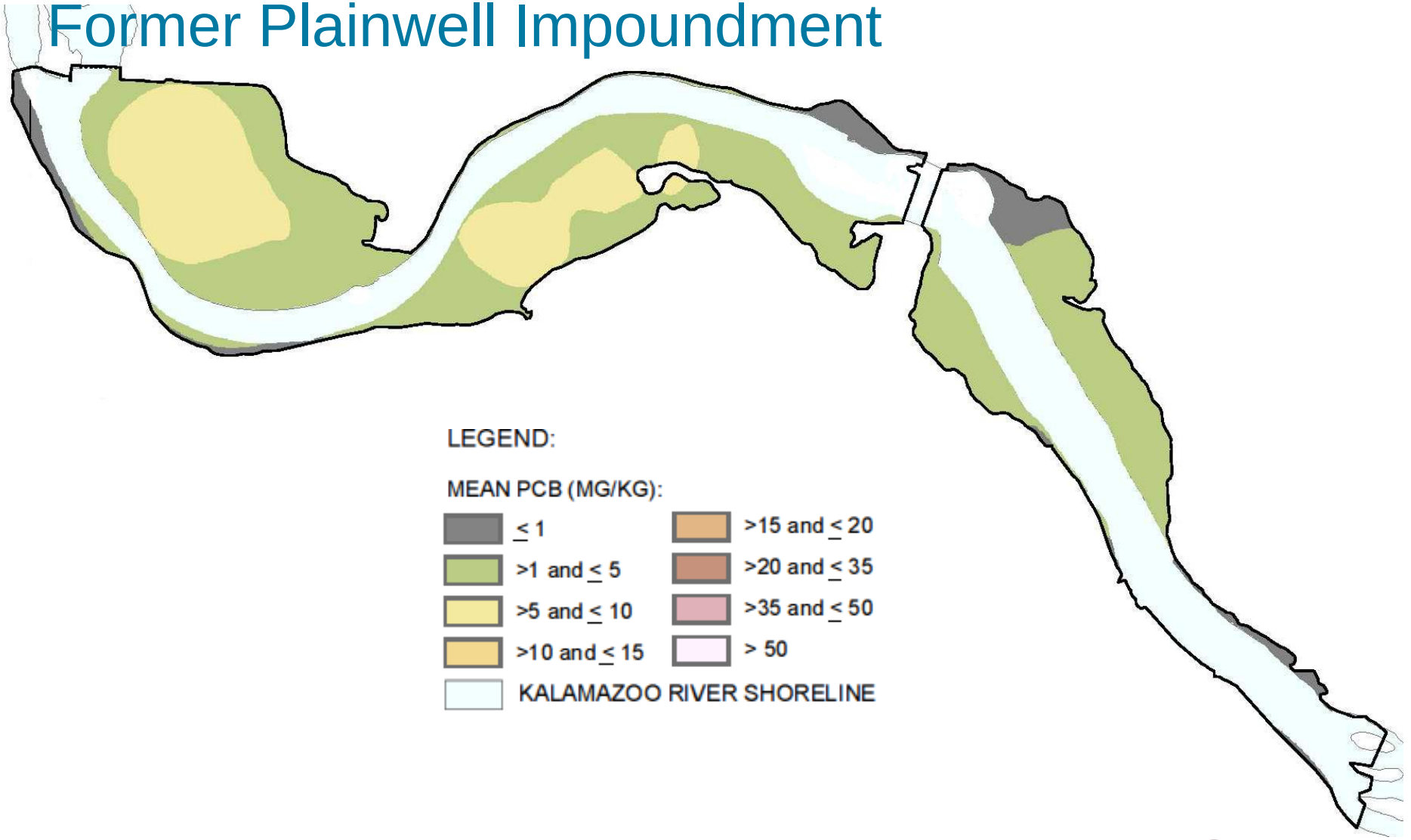
Natural Neighbor – 11-Acre Moving Window
Former Plainwell Impoundment



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Risk Results – Insectivorous Birds
House Wren

- The house wren has an AHR genetic sequence that indicates they are type 2 (i.e., moderately sensitive and not chicken-like)
- All HQs: dietary tPCB; egg-based tPCB and TEQ; NOAEL and LOAEL for mid-range sensitivity TRVs are ≤ 1
- MSU house wren productivity study in former Trowbridge Impoundment (where soil PCB concentrations are higher than those in Area 1) indicate no adverse effects on productivity of house wrens, measured as no differences in clutch size, hatching success, or overall productivity between the Site and reference

Conclusions: No risk in Area 1 to local populations of insectivorous birds

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Risk Results – Vermivorous Birds
American Robin

- The American robin has an AHR genetic sequence that indicates they are type 2 (i.e., moderately sensitive and not chicken-like)
- All HQs, dietary tPCB; egg-based tPCB and TEQ; NOAEL and LOAEL for mid-range sensitivity TRVs are $\leq$ 1 in both the Plainwell No. 2 Dam Area and the former Plainwell Impoundment
- Estimated robin egg concentrations in former Plainwell Impoundment and the Plainwell 2 Dam Area range from 0.1 to 30.1 mg/kg based on soil to egg BAFs
- Measured robin egg concentrations in former Plainwell impoundment (pre TCRA) ranged from 0.8 to 11 mg/kg with a mean concentration of 4.4 mg/kg

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Risk Results – Vermivorous Birds
American Robin (continued)

- Housatonic Robin Study indicates concentrations in eggs of up to 84 mg/kg tPCB did not adversely impact robin populations
- The TEQ concentrations in the prey base (i.e., worms) is similar (Housatonic average TEQs = 223 ng/kg for non depurated worms and Kalamazoo average was 238 ng/kg) thus, it can be inferred that no effects on vermivorous bird populations would be expected for the Kalamazoo at these concentrations

Conclusions: No risk to local populations of American robins in Area 1

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Risk Results – Vermivorous Birds
American Woodcock

- American woodcock has an AHR genetic sequence that indicates it is type 2 (i.e., moderately sensitive and not chicken-like)
- All HQs (dietary and egg-based tPCB and TEQ) based on LOAELS for mid-range sensitivity TRVs are < 1 in the former Plainwell Impoundment
- 7% of potential home ranges for the American woodcock may have HQs > 1 based on dietary mid-range sensitivity NOAEL TRVs
- All HQs based on mid-range sensitivity TRVs are < 1 in Plainwell No. 2
- Egg-based HQs (tPCB and TEQ) based on mid range sensitivity NOAEL TRVs are all < 1 in both areas

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Risk Results – Vermivorous Birds
American Woodcock (continued)

- Woodcocks have relatively large home ranges (11 acres), thus, a small number of woodcock pairs would be expected in either of the two former
  - Former Plainwell Impoundment – 5 pairs
  - Plainwell No. 2 Dam Area – 8 pairs

  (for context, a minimum viable population would consist of approximately 1200 pairs)
- The number of potential woodcock home ranges with NOAEL-based HQs >1 is 7% of the 5 possible in the former Plainwell Impoundment (i.e., < 1pair)

Conclusions: No risk to local populations of American woodcock in Area 1

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HQs for High Sensitivity TRVs

- HQs using high sensitivity egg-based TRVs would indicate catastrophic effects on avian species that are not borne out by field observations (results for the former Plainwell Impoundment, Approach 2 used for example)
  - House Wren and American Robin (2 acre home range EUs)
    - Total PCB: 84% of potential home ranges with NOAEL-based HQ > 1
      70% of potential home ranges with LOAEL-based HQ > 1
    - TEQ: 92% of potential home ranges with NOAEL-based HQ > 1
      84% of potential home ranges with LOAEL-based HQ >1
  - American Woodcock (11 acre home range Eus)
    - Total PCB: 91% of potential home ranges with NOAEL-based HQ > 1
      77% of potential home ranges with LOAEL-based HQ > 1
    - TEQ: 96% of potential home ranges with NOAEL-based HQ > 1
      91% of potential home ranges with LOAEL-based HQ >1

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Interpretation of HQs for High Sensitivity TRVs

- HQs for High Sensitivity TRVs not in Agreement with other LOE
- High Sensitivity TRVs are not representative of species expected in the Kalamazoo River floodplains
- Species evaluated in the BERA selected to represent highest potential exposure
- Species with higher exposure in combination with chicken-like sensitivity to PCBs have not been observed and are not expected within the Kalamazoo River floodplains

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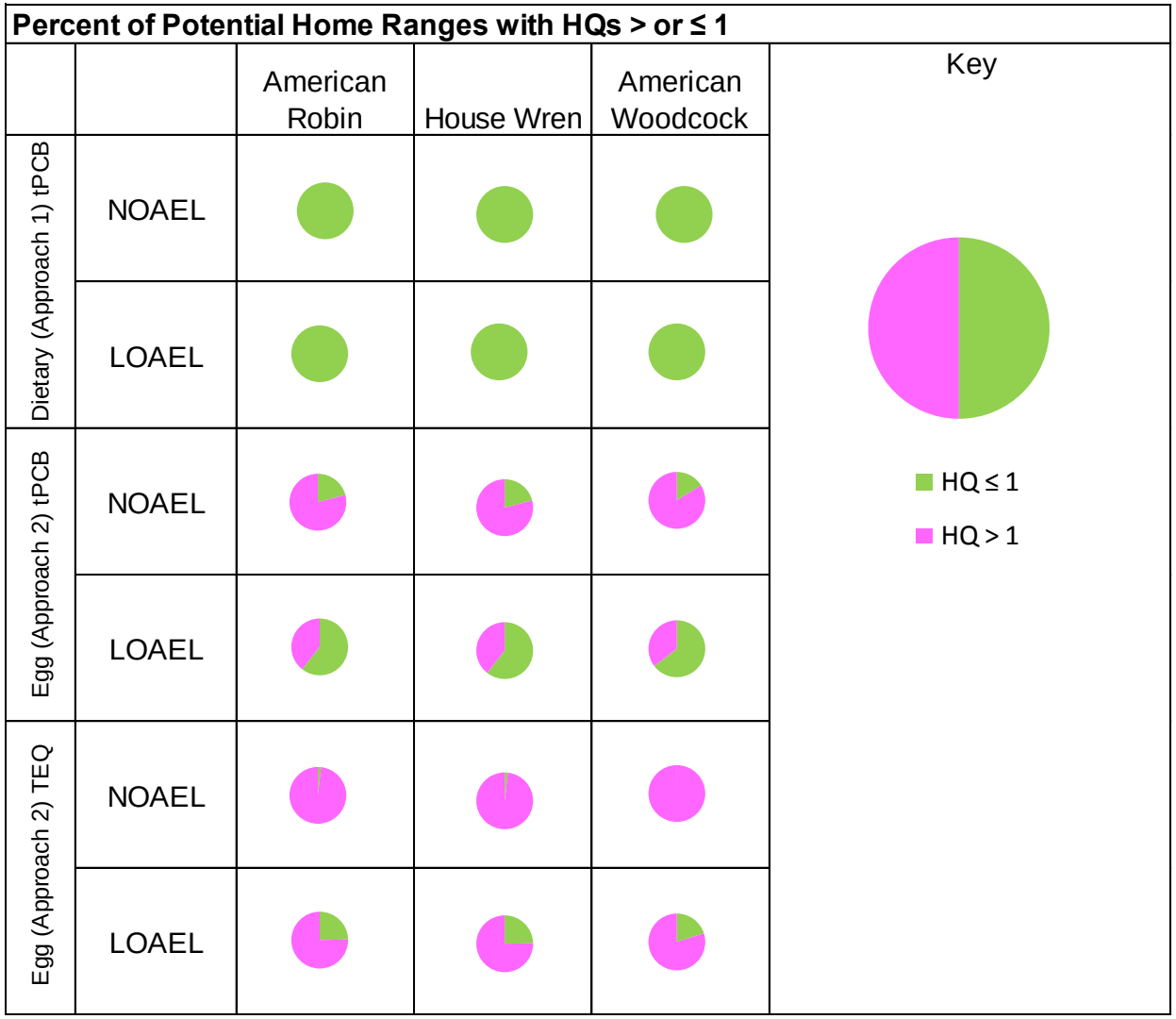
HQ Summary: High Sensitivity TRVs

Plainwell No. 2 Dam Area

Small Ranging Avian Receptors

The high-sensitivity HQs were computed as agreed with TRV work group; however, these results are not viewed as representative of any wild species which raises the question of what, if any, weight to place on these results in the BERA Report – or if these should be viewed in the context of uncertainty around the conclusions.



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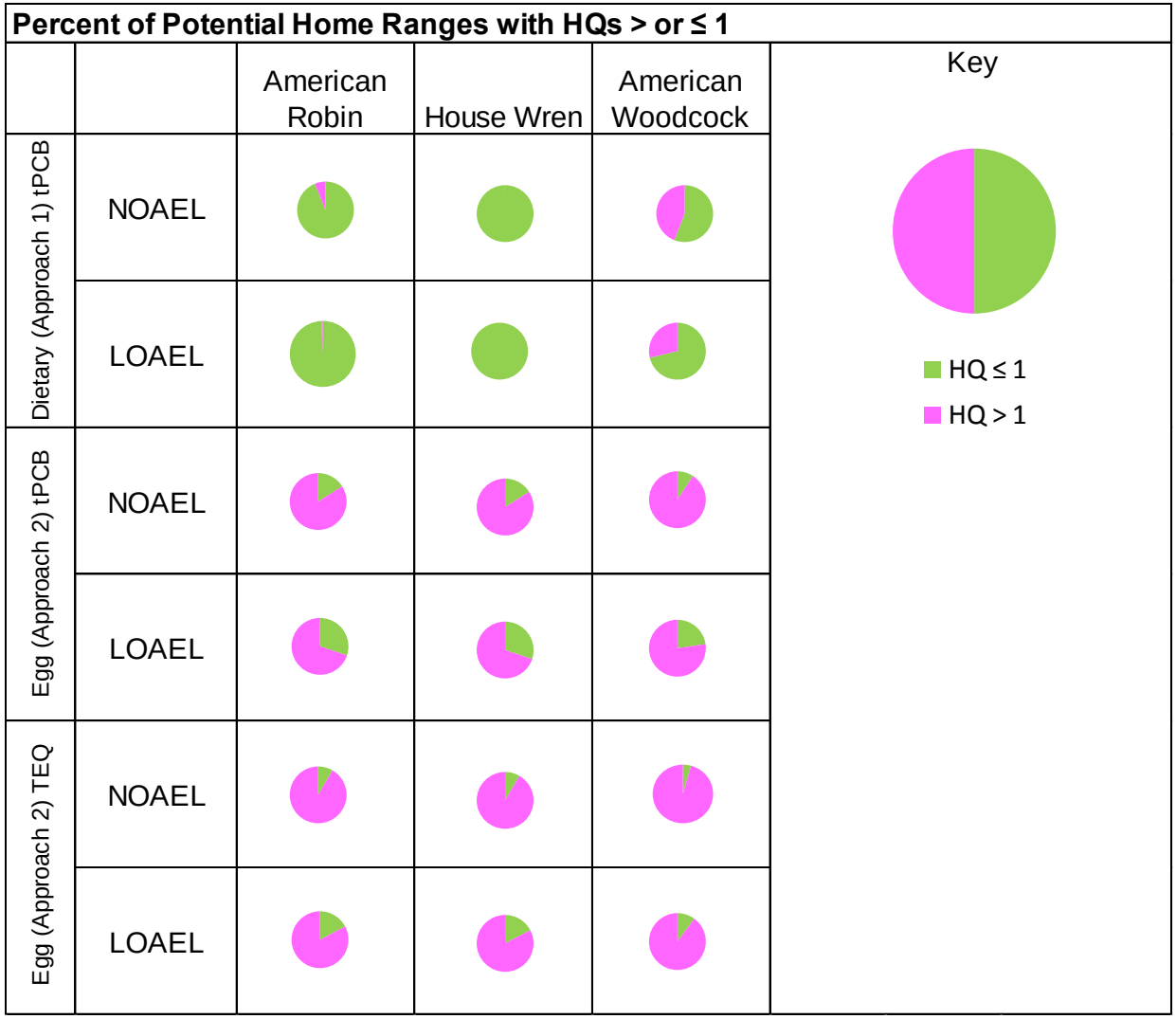
HQ Summary: High Sensitivity TRVs

Former Plainwell Impoundment
Small Ranging Avian Receptors

The high-sensitivity HQs were computed as agreed with TRV work group; however, these results are not viewed as representative of any wild species which raises the question of what, if any, weight to place on these results in the BERA Report – or if these should be viewed in the context of uncertainty around the conclusions.



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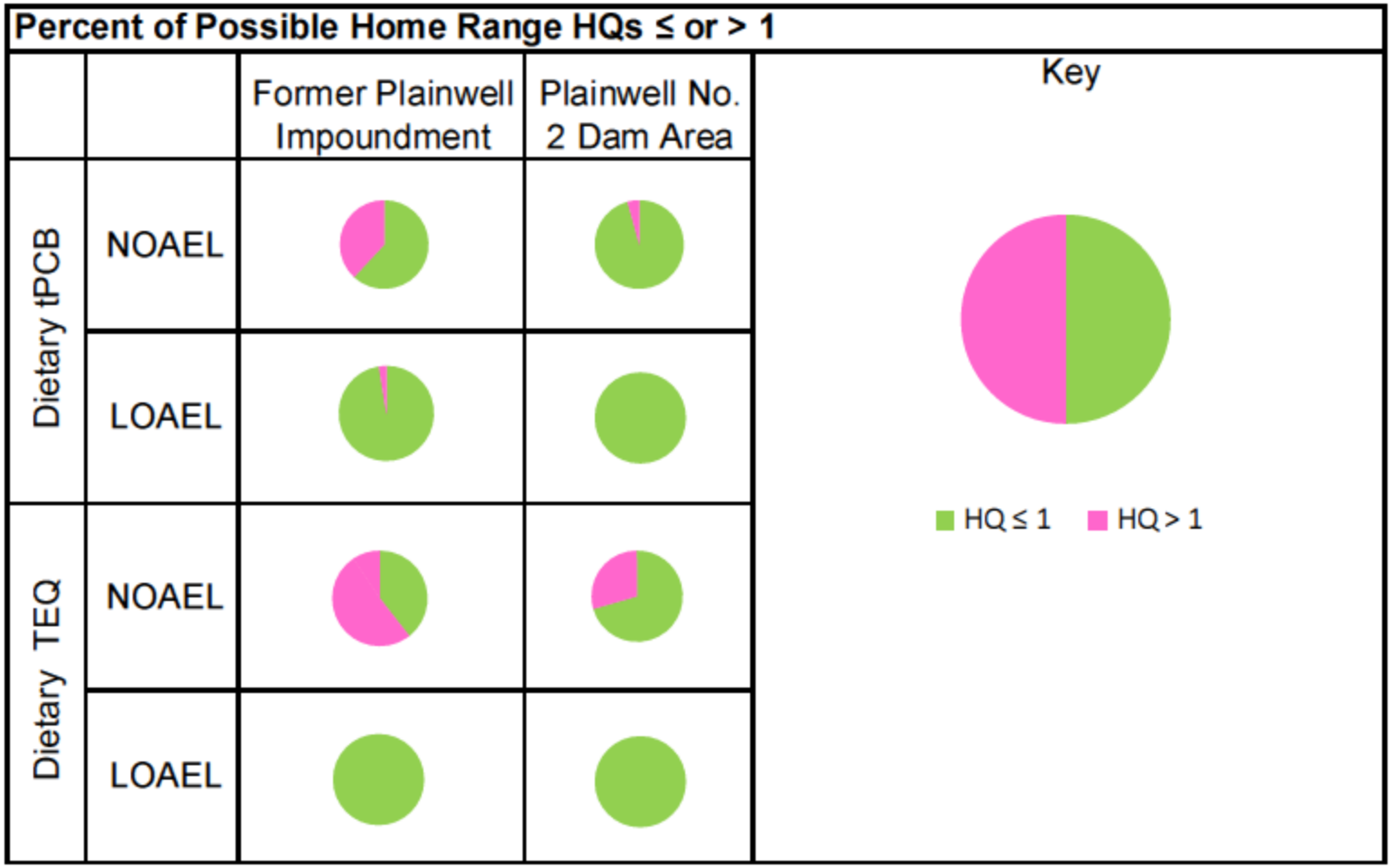
HQ Summary: Vermivorous Mammals



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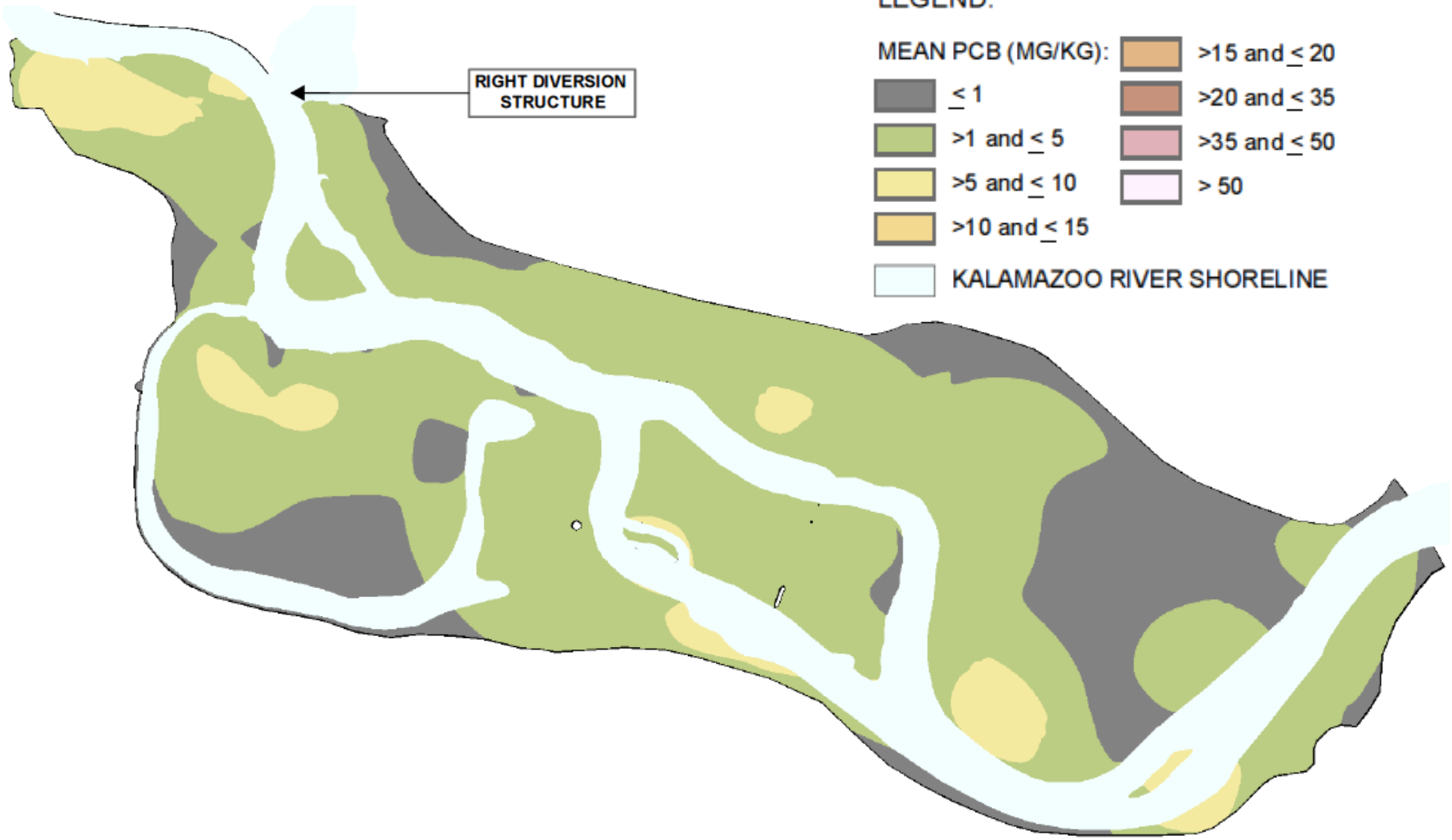
Natural Neighbor - 1 Acre Moving Window
Plainwell No. 2 Dam Area



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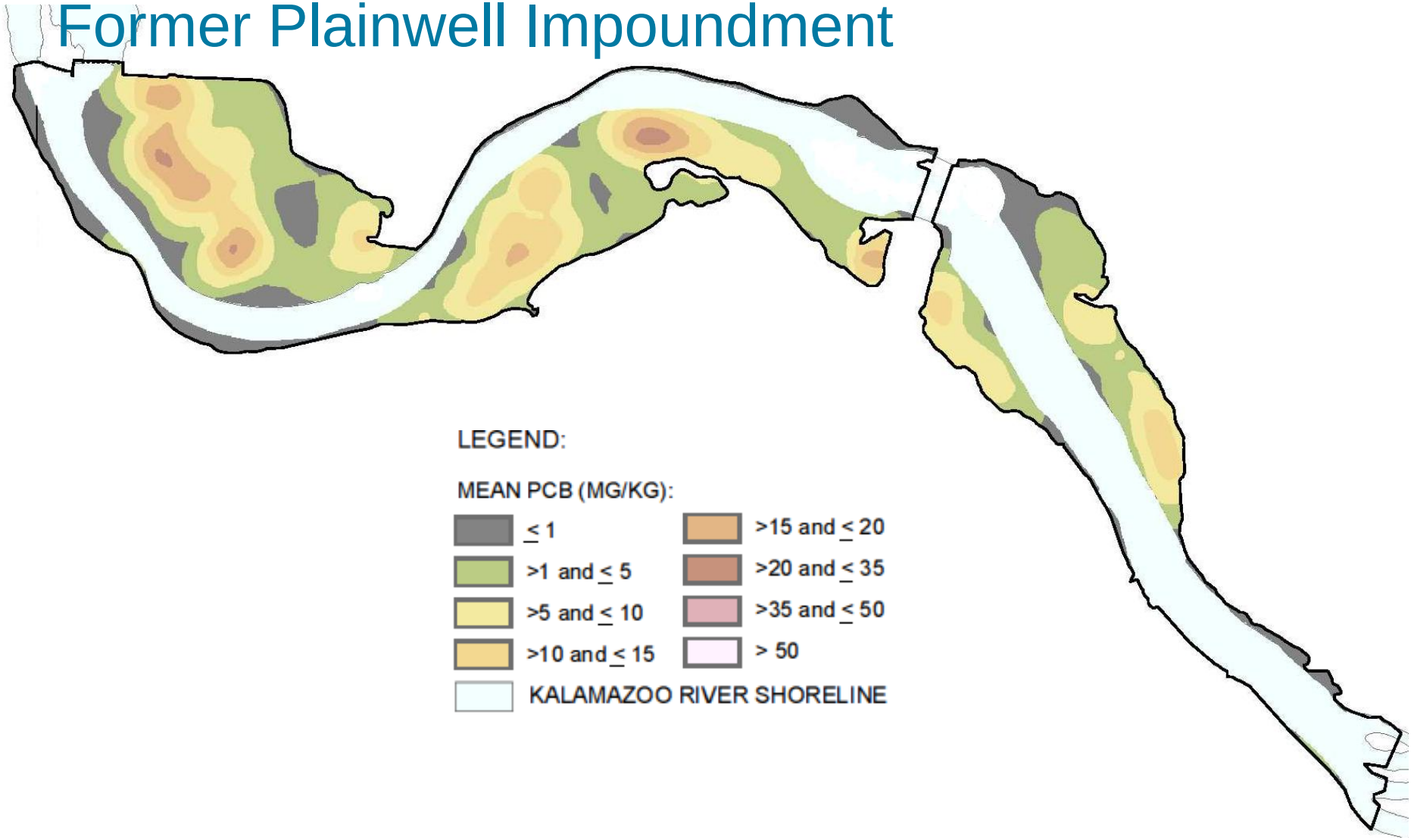
Natural Neighbor – 1-Acre Moving Window
Former Plainwell Impoundment



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Risk Results – Vermivorous Mammals
Short-tailed Shrew

Total PCB HQs Plainwell No. 2 Dam Area

- NOAEL – 98% of potential home ranges had HQs $\leq$ 1 and 2% had HQs > 1
- LOAEL – 100 % of potential home ranges had HQs < 1

TEQ HQs Plainwell No. 2 Dam Area

- NOAEL – 73% of potential home ranges had HQs $\leq$ 1 and 27% had HQs > 1
- LOAEL – 100 % of potential home ranges had HQs < 1

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Risk Results – Vermivorous Mammals
Short-tailed Shrew (continued)

Total PCB HQs former Plainwell Impoundment

- NOAEL – 66% of potential home ranges had HQs $\leq$ 1 and 34% had HQs > 1
- LOAEL – 99 % of potential home ranges had HQs $\leq$ 1 and 1% had HQs > 1

TEQ HQs Former Plainwell Impoundment

- NOAEL – 41% of potential home ranges had HQs $\leq$ 1 and 59% had HQs > 1
- LOAEL – 100 % of potential home ranges had HQs < 1

TRVs were lowest values available in the literature for small mammals (non mink)

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Risk Results – Vermivorous Mammals
Short-tailed Shrew (continued)

- HQs indicate that small mammals are not likely at risk based on LOAEL HQs
- Housatonic shrew study indicated that shrews living in areas with soil concentrations of 21 mg/kg were not adversely affected by PCBs
- The number of shrew pairs potentially present is 59 and 89 pairs in former Plainwell Impoundment and Plainwell No. 2 Dam Area, respectively (based on 1 acre home ranges)
- The number of potential shrew home ranges with LOAEL-based HQs >1 is 1% of the 59 possible in the former Plainwell Impoundment (i.e., < 1pair)

Conclusions: No risk to local populations of small mammals in Area 1

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HQ Summary: Wide Ranging Receptors

Receptor	High Sensitivity TRVs[1]		Mid-Range Sensitivity TRVs	
	NOAEL	LOAEL	NOAEL	LOAEL
Former Plainwell Impoundment				
Red-tailed Hawk tPCB - 1[2]	0.27	0.22	0.18	0.060
Red-tailed Hawk tPCB - 2[3]	0.28	0.22	0.19	0.062
Fox tPCB - 1[2]	0.45	0.15	--	--
Fox tPCB - 2[3]	0.48	0.16	--	--
Plainwell No. 2 Dam Area				
Red-tailed Hawk tPCB - 1[2]	0.19	0.15	0.13	0.042
Red-tailed Hawk tPCB - 2[3]	0.20	0.16	0.13	0.044
Fox tPCB - 1[2]	0.32	0.11	--	--
Fox tPCB - 2[3]	0.34	0.11	--	--

Notes:

[1]Only one set of TRVs was developed for mammals. These values are considered protective of the range of species found in Area 1.

[2]Scenario 1 was calculated using a soil to bird bioaccumulation factor.

[3]Scenario 2 was calculated using a soil to terrestrial invertebrate to adult bird tissue series of bioaccumulation factors at the request of USEPA.

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Conclusions

- No risk to wide-ranging carnivorous birds or mammals
- No risk to local populations of insectivorous birds
- No risk to local populations of vermivorous birds
- No risk to local populations of vermivorous mammals

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